Health Risk Assessment Guidance for Rail Yard and Intermodal Facilities

California Air Resources Board

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Introduction

These guidelines will help ensure that the air dispersion modeling and health risk assessment (HRA) performed for each rail yard meet the requirements in the ARB/Railroad Statewide Agreement. The rail yard HRA shall follow the Air Toxic Hot Spots Program Risk Assessment Guidelines (Risk Assessment Guidelines) published by the Office of Environmental Health Hazard Assessment (OEHHA), and be consistent with the Roseville Rail Yard Study performed by ARB staff.

The HRAs will identify the associated risk from on-site activities. The HRAs will consider emissions of toxic air contaminants (TACs) from emission sources at each Designated Rail Yard including resident and transient locomotives, on- and off-road equipment, and stationary equipment. In addition, ARB staff will provide additional information on the risk from nearby off-site sources. In performing the HRAs, the railroads will collect and submit air emissions, meteorological, demographic, and air dispersion modeling data to ARB.

South Coast Air Quality Management District adopted Rule 3503 in October 2005 which also requires emission inventories and health risk assessments for rail yards within the district. Most of the components in these guidelines parallel the requirements in Rule 3503. ARB HRA guidelines are designed to represent a statewide framework for the development of rail yard HRAs. ARB staff acknowledges that local considerations may result in the need for minor deviations from these guidelines. As such, rail yard health risk assessments conducted under the guidance established by an air pollution control or air quality management district (local district) may be accepted subject to the review of ARB staff. In the interest of statewide consistency, however, ARB staff encourages local districts to work with us to resolve the differences.

Air Dispersion Modeling

Air dispersion modeling uses mathematical formulations to characterize the atmospheric processes that disperse a pollutant emitted by a source. Conducting air dispersion modeling is a critical step of exposure assessment in an HRA. In implementing the model, a basic understanding of dispersion modeling is presumed. Detailed regulatory modeling procedures shall follow U.S. EPA's Guidance on Air Quality Models.

Facility Description and Source Information

The HRA report should contain a brief description of the facility and its activities as shown in the detailed HRA report outline provided in Appendix A. Table 1 lists the information on the facility and its surroundings that must be provided in the modeling analysis. The facility location is used to determine the most representative meteorological data for the analysis. The nearby land use is needed to properly reference receptors as residential, commercial, industrial, sensitive, etc.

The facility plot plan (including a length scale) is needed to determine all stationary and mobile source locations (including their elevations above sea level), building dimensions, truck and train routes, truck and train idling activities, cargo handling activities, other on- and off-road equipment activities, and the property boundary. Table 2 lists the potential sources that must be included in the HRA. The operating profile, the hourly emission

rates, the annual average emission rates, and the source parameters listed in Table 1 are necessary to accurately characterize the source emissions. It is acceptable to estimate the hourly emission rate of certain equipment based on operating profiles. The reader is referred to the detailed outline provided in Appendix A for additional information and guidance.

Table 1. Required Source Information.

Information on the Facility and its Surroundings

- Location (i.e., address and UTM coordinates)
- Local land use (within 3 km) and general land use description (within 20 km)*
- Local topography (within 20 km)*
- Facility plot plan in GIS format (NAD83, UTM 10N/11N)
  - Property boundaries
  - Horizontal scale
  - Building dimension (for building downwash calculations)
  - Stationary source locations including elevations
    - Maintenance and servicing areas
    - Fueling areas
    - Vehicle entrance and exit of rail yard
    - Weigh and dispatch stations
    - Switching, classification, hump location, yard sidings and spurs
  - Locations of truck and train idling activity including elevations
    - Locomotive and truck crossing locations, weigh and dispatch stations
    - Truck queuing prior to loading
  - Truck and train routes within the facility
    - Including crossing locations
  - Cargo handling activities
    - Maintenance, servicing, storage, mobile fueling locations
    - Intermodal loading/unloading, chassis loaders and stackers, yard hostlers, etc.
    - Any off-site staging areas associated with the rail yard or intermodal facility operation.
  - Any off-site staging areas associated with the rail yard or intermodal facility operation**

Point Source Information (stacks, vents, etc.)

- Annual emissions
- Operating profile (e.g., seasonal, monthly, weekly, or daily operating schedule)
- Maximum and average hourly emission rates
- Stack location (in UTM coordinates) on plot plan including elevation
- Stack layout (vertical, horizontal, raincap, or other)
- Stack height
- Stack diameter
- Stack gas exit velocity
- Stack gas exit temperature
- Nearby building dimensions, heights, locations (in UTM coordinates), and base elevations

Mobile and Fugitive Source Information (i.e., area and volume sources)

- Maximum and average hourly emission rates
- Annual emissions
- Source location (in UTM coordinates) on plot plan including elevations

- Source height
- Area or volume dimensions, vertices for polygon area sources

* General descriptions of land use and topography within 20 km from the geographic centroid of the facility will be used to facilitate the analysis of the health risk of the entire zone of impact. The land use input for air dispersion modeling can be obtained by following the recommendation of Auer land use analysis methodology specified in EPA Guideline on Air Quality Model [3].

** Staging areas are defined as activity areas located within one mile from any rail yard boundary that would not exist other than for the existence of the rail yard, and include truck queuing areas and container storage and organization areas. Nearby highways and surface streets are not included in this definition.

Source Treatment

On-road and off-road mobile emission sources, such as trucks, locomotives, cargo handling equipment, etc., should be treated as point or area sources when stationary or idling and as volume sources when moving. Stack parameters representative of the fleets of trucks, locomotives, and cargo handling equipment for the rail yard should be used. The stationary or idling mobile equipment are not typically uniformly distributed throughout the facility. Their location in the dispersion modeling should be based on a detailed study and survey of the facility activity; emissions should only be placed where activity occurs.

Emissions from the movement of trucks and trains should be simulated as a series of volume sources along their corresponding routes of travel. A typical rail yard or intermodal facility can have a large number of individual sources; the ARB modeling for the Roseville Rail Yard Study[2] included about 20,000 individual sources. For each rail yard, the railroad shall make the judgment of the source treatment to each type of emission source within its boundary, subject to ARB review. In order to simplify the model input, the participating rail yards may, upon approval of ARB, exclude certain insignificant emission sources from the air dispersion modeling, provided that the contribution of such sources to the overall rail yard risk is negligible (refer to the discussion of de minimus level in ARB rail yard emission inventory guideline).

It is acceptable and even encouraged to combine sources into large area or volume sources or smaller sets of point sources in order to make the modeling analysis manageable. Like or related pollutant sources with similar source parameters may be combined. For volume sources, footprint should remain within the confines of the activity. Spreading the emissions to areas outside the activity is not acceptable. Appropriate volume source heights for the trucks and trains can be estimated by calculating effective plume height under expected travel speeds, atmospheric stability conditions, and stack parameters representative of the truck and train fleet. Appropriate stack parameters for consolidated truck and/or locomotive sources should be based on average profiles for the fleet(s). Justification of such consolidation/simplification (such as sensitivity tests) should be provided for review by ARB staff.

Two important modeling input parameters are initial lateral and vertical dimensions and should be calculated according to the recommendations in the corresponding air

dispersion modeling user's guide.[4] and [13] Table 3 recommends the air dispersion modeling source treatment for typical sources expected at a rail yard.

Table 2. Potential Emission Sources for Consideration in the HRA.

Source Category	Examples
Stationary	Boilers (all fuels), water heaters (all fuels), emergency generator sets and fire pumps (all fuels), fuel dispensing (LPG, gasoline, diesel, etc.), fuel storage tanks (LPG, gasoline, diesel, etc.), waste water treatment facilities, solvent cleaning units.
On-road mobile	heavy duty diesel trucks (idling & moving), crew vans, crew trucks (diesel fuel)
Off-road mobile	transport refrigeration units, overhead cranes, side loaders, chassis stackers, chassis loaders, yard hostlers, rubber tire gantry cranes, utility trucks, dozers, forklifts, locomotives (switchers and line haul)

Table 3. Air dispersion modeling source treatment for typical rail yard sources*.

Source Category	Specific Sources	Source Treatment
Stationary	Natural gas boilers & water heaters	Point
	Diesel & natural gas emergency generators	Point
	Diesel & gasoline fuel pumps	Point
	Fire water pumps	Point
	Fuel storage tanks with floating roofs	Volume or Area
	Fuel storage tanks with vent valves	Point
	Waste water treatment facilities	Point or Area
On-road mobile	Heavy duty diesel trucks (idling)	Point
	Heavy duty diesel trucks (moving)	Volume or Area
	Crew vans & trucks (diesel fuel)	Volume or Area
Off-road mobile	Overhead cranes	Volume or Area
	Side loaders	Volume or Area
	Chassis stackers	Volume or Area
	Chassis loaders	Volume or Area
	Yard hostlers	Volume or Area
	Rubber tire gantry cranes	Volume or Area
	Utility trucks	Volume or Area
	Dozers	Volume or Area
	Forklifts	Volume or Area
	Locomotives (moving)	Volume or Area
	Locomotives (idling)	Point

* Source type selections in Table 3 are ARB recommendations. Rationale for selection of different source types (i.e., based on site-specific considerations) should be provided to ARB for review.

Stacks with Raincaps and Area Sources

Emission release points with raincaps or which are oriented so that the exhaust is vented downward or horizontally may not use the velocity inside the stack as the vertical velocity of the point source in the model. These stacks may be modeled with a positive

vertical velocity of no more than 0.001 meters per second, with the stack tip downwash option turned off and the stack height reduced by 3 times of the stack diameter. Detailed calculation should follow discussion in OEHHA's Technical Support document for Exposure Assessment and Stochastic Analysis [14]. In general, if there is uncertainty on how to represent sources in a model, ARB staff should be consulted before proceeding with modeling.

According to U.S. EPA guidance for area sources in ISCST3,[4] the aspect ratio (i.e., length/width for area sources should be less than 10 to 1. If this is exceeded, then the area should be subdivided to achieve a 10 to 1 or less aspect ratio for all sub-areas.

Model Selection and Model Options

On November 9, 2005, U.S. EPA promulgated AERMOD, a state-of-science air quality dispersion model, as the preferred air dispersion model in the Agency's "Guideline on Air Quality Models" in place of the currently used Industrial Source Complex Model Short Term Version 3 (ISCST3) model. Therefore, AERMOD is primarily recommended for the forthcoming HRAs in the participating rail yards.

ARB staff acknowledges that ISCST3 model has been broadly used in the air toxic risk assessment programs, such as Roseville Rail Yard HRA Study. As such, the use of ISCST3 as dispersion model in the HRAs may be accepted on a case-by-case basis. Other alternative air dispersion models (CALPUFF etc.) may also be accepted upon approval of ARB staff.

The emissions of diesel particulate matter (DPM) must be separated from other particulate related TAC emission data in the model input files, and the model output must include a separate file of DPM concentration.

The building downwash effects should be addressed when emissions occur at or below the Good Engineering Practice height as defined by U.S. EPA Guidance. Detailed information shall be obtained from U.S. EPA's Guidance on Air Quality Models. ARB staff acknowledges that the effect of building downwash depends on the source-receptor distance. Whether the downwash effect should be considered for a specific emission source will be determined on a case by case basis, subject to review of ARB staff.

Dispersion coefficients are used in the ISCST3 air dispersion model to reflect the land use (rural or urban) over which the pollutants are transported. The coefficients are yard specific parameters. Each participating rail yard should identify the dispersion coefficients, if applicable, based on the land use characteristics of the rail yard and its surroundings, subject to review by ARB staff. AERMOD dose not rely on rural or urban classification. It requires the surface roughness, Albedo, Bowen ratio surrounding the meteorological station, and meteorological obervations to calculate the Monin-Obukhov length.

Meteorological Data

The meteorological data used in the model must be selected on the basis of spatial and temporal representativeness. While it may be ideal if the nearest station is also the most representative, an intervening terrain feature may dictate the use of an alternate site. The determination of representativeness should include a comparison of the surface characteristics (i.e., the surface roughness, the Albedo, and the Bowen ratio) between the meteorological site and the source location, coupled with an evaluation of the importance of those differences relative to predicted concentrations. For those rail yards with multiple candidate stations, selection of meteorological data set will be based on topography, proximity, data completeness, data availability, and wind rose evaluation. ARB staff must approve the meteorological data set(s) (including upper air sounding data) used in the dispersion modeling prior to its use to ensure that the most representative meteorological station is chosen for the modeling.

Wind speeds may be stored as scalar averages or vector averages. The scalar average of wind speed should be used in the dispersion modeling according to U.S. EPA's Guidance on Air Quality Models. If scalar averaged wind speed data are not available, the rail yard can choose vector wind speed data for model input subject to review of ARB staff, provided that the data is representative and complete for modeling.

Under the calm conditions, the user should follow U.S. EPA regulatory default or corresponding guideline established by the local district.

If AERMET is used for meteorological data processing, its methodology should be provided to ARB for review.

According to OEHHA Risk Assessment Guidelines, 5-years of representative meteorological data, if available, should be used in dispersion modeling analysis. Subject to review of ARB staff, a shorter time period (at least 1 year) of meteorological data is acceptable if appropriate justification for using the data without losing representativeness is provided.

Model Domain and Receptor Grid

Air dispersion modeling is required to estimate (a) annual average concentrations to calculate the Maximum Exposed Individual (MEI), the Maximum Exposed Individual Worker (MEIW); the Maximum Individual Cancer Risk (MICR), which is simply the greater of the MEIR and MEIW; the maximum chronic HI, the zones of impact, and excess cancer burden and (b) peak hourly concentrations to calculate the health impact from substances with acute non-cancer health effects. To achieve these goals, the receptor grid should begin at the facility fence line and extend to cover the zone of impact.

Generally, ARB recommends a model domain covering 20 km by 20 km area, but recognizes that smaller modeling domains may be sufficient for some yards while larger domains may be needed for other yards. The domain should be chosen to cover the zone of impact, for example, the 1 in a million isopleths of cancer risk in the health risk assessment. A preliminary screening study to identify the zone of impact should be conducted prior to the identification of model domain. However, the extent of the model

domain should also be based on the limits of the model's capability/accuracy (50 km) and technical or professional judgment on the accuracy of the model predictions.[3]

The receptor grid should be identified with sufficient detail to permit the characterization of the cancer and non-cancer risks from individual rail yard emissions. The receptor network may include fine, medium, and/or coarse receptor grids around each rail yard. The size and resolution of the receptor grid should be based upon an evaluation of the emissions profiles at each rail yard. A coarse Cartesian grid receptor network (500 m x 500 m) should be used to cover the extent of the modeling domain. A fine grid network (50 m x 50 m) should be used where appropriate, such as for modeling near-source (within 1 km of the fence lines) or sensitive receptors, as well as points of maximum impact in accordance with OEHHA guidance. Sensitive receptors, such as schools and locations identified by the local community as receptors of potential concern (within a 1 mile radius of each yard), should be identified separately by exact UTM coordinates (NAD83, UTM 10N/11N). Sensitive receptors should be identified using information available from ARB potential sensitive receptor sites. A medium grid network (250 m x 250 m) is recommended for use around the finer grid network to provide additional resolution beyond 1 km of the fence lines. An additional grid network (100 m x 100 m) may be used around the finer grid network if additional resolution appears to be necessary based on professional judgment of ARB staff. All receptors should be identified in UTM coordinates (NAD83, UTM 10N/11N). Elevations must be provided for all receptors. United States Geological Survey (USGS) 7.5 Minute digital elevation model (DEMs) information will be used to identify terrain heights, if applicable. Receptor grid points outside of the facility boundary with grid spacing of 100 meters or more must be placed so that individual grid points are placed at UTM coordinates ending in "00" (e.g., grid point UTM East 572300 and UTM North 3731000). Receptor grids with less than 100 meter spacing must include grid points at UTM coordinates ending in "00".

The density of the receptor network can be relaxed in downwind regions outside the peak impact area. The network must only be sufficiently dense to develop the 1, 10, 25, 100, 250, 500, 1000, 2500, 5000, etc. in a million potential cancer risk isopleths and the 0.5, 1, 3, 5, and 10 non-carcinogenic chronic health hazard index isopleths, based on the limits of the model's capability/accuracy as discussed above.

Demographic Data

Demographic data are important parameters in HRAs. Population census based on 2000 or later United States census data in a GIS map (NAD83, UTM 10N/11N) format should be provided for all areas included in the modeling domain. Demographic data can be used prior to the modeling exercise to assist in the selection of model domain.

Uncertainty and Sensitivity Analysis

Uncertainties of the exposure assessment (air quality modeling) are associated with uncertainties in the input values of the known conditions. Uncertainties include source characteristics (emissions, stack parameters) and meteorological inputs. Uncertainty

analysis is usually performed through conducting a series of sensitivity studies to evaluate how the uncertainty of model input parameters affect the estimates. The following parameters could be considered in the sensitivity studies: model domain and resolution, emission rate, source treatment (point, line, area, or volume source), meteorological data selection, and dispersion coefficient.

The uncertainty and sensitivity analysis of the air dispersion modeling are highly recommended to be performed for each designated yard. Detailed information shall be referred from page 46 of the Roseville Rail Yard Study. In the report to be submitted to ARB, the railroads must identify which of the input parameters has higher uncertainty on results of air dispersion modeling.

Risk Assessment

ARB staff will conduct the draft Health Risk Assessment (HRA) based on the emission inventory and air dispersion modeling outputs/information provided for each Designated Rail Yard. The Tier 1 HRA evaluation methodology, as described in OEHHA's Risk Assessment Guidelines, will be used. ARB requires that all stationary source HRAs be prepared in accordance with OEHHA guidance.[5] This guidance is implemented through the ARB computer program called, Hotspots Analysis and Reporting Program (HARP).[6] HARP is a convenient and preferred tool to evaluate risks from multiple sources emitting multiple toxics. However, given the many and varied activities at a typical rail yard or intermodal facility, HARP may not be the best tool for simulating the risks from the diesel particulate sources. Such sources may be best treated directly by air dispersion modeling and the risks estimated using procedures outlined in Appendix B. It is suggested, but not required, that HARP be used for all the non-diesel sources and that the results from the two approaches be combined. OEHHA guidance assumes that risks are additive.

Uncertainty in Risk Assessment

ARB staff recognizes that there can be uncertainty in health risk assessments. It is appropriate to include a discussion on the topic of risk assessment uncertainty in the Executive Summary and main body of the HRA. Any discussion of uncertainty must consider both the factors that contribute to risk overestimation and those that contribute to risk underestimation (see pages 1-4 and 1-5 of the OEHHA Guidelines[5]).

Toxic Pollutants Considered in the HRA

Emissions of all compounds in Appendix A-I of the OEHHA Guidelines[5] must be quantified and included in the HRA. For organic compounds, if ARB's SPECIATE database does not indicate the presence of a specific TAC for a specific source category, as of June 1, 2006, that category will not be included in the inventory for that TAC. Appendix A-I in the OEHHA Guidelines[5] provides a "degree of accuracy" for each compound, which is nothing more than a de minimus emission level for reporting.

The degree of accuracy for diesel particulate matter given in Appendix A-I is inappropriate since it was established before OEHHA developed a cancer potency for diesel particulate. Thus, all emissions of diesel particulate matter must be reported and included in the HRA.

Although OEHHA has developed acute and chronic reference exposure levels (RELs) for many criteria pollutants, such as carbon monoxide, nitrogen dioxide, ozone, and sulfur dioxide, emissions of these pollutants should not be included in the HRA.

Risk Assessment Guidance

All the rail yard HRAs will include a Tier-1 evaluation, which is defined by OEHHA as a point estimate using standard assumptions. Tier-2, Tier-3, and Tier-4 evaluations may be prepared and presented in the HRA. However, the results from any Tier-2, Tier-3, or Tier-4 evaluations will be presented in separate, clearly titled, sections, tables, figures, and text. Table 4 summarizes the risk assumptions required by the ARB HRA Guidelines. These requirements are discussed in more detail next.

Residential cancer risks assume a 70-year exposure and could include the following pathways: home grown produce, dermal absorption, soil ingestion, and mother's milk. A deposition velocity of 0.02 m/s should be assumed for the non-inhalation pathways. The HRA should assume the default value of 5.2 percent for the fraction of homegrown fruits and vegetables consumed for urban site, and 15 percent for non-urban site. The other pathways of fish ingestion; dairy milk ingestion; drinking water consumption; and meat (i.e., beef, pork, chicken, and egg) ingestion should be included only if the facility impacts a local fishable body of water, grazing land, dairy, or water reservoir. The "Derived (Adjusted)" risk calculation method[8] should be used for estimating cancer risks at residential receptors. To estimate chronic non-cancer risks at residential receptors the "Derived (OEHHA)" risk calculation method[9] should be used. ARB will estimate the mortality (premature death) effects associated with diesel particulate matter emissions for the "region" where the Designated Rail Yard is located. The analysis of regional mortality effects and emissions will be a separate process from estimating the individual rail yard emission and the contribution of the individual rail yard emission to the region.

Worker cancer risks assume a 40-year exposure and may include the pathways of dermal absorption and soil ingestion. A deposition velocity of 0.02 m/s should be assumed for these pathways. The "Point estimate" risk calculation method should be used for estimating potential cancer and non-carcinogenic chronic health hazards at worker receptors.

The air concentration that the neighboring workers breathe when present at work is different than the annual average concentration calculated by the dispersion model. The annual average estimated by the dispersion model is a 24 hours per day, 7 days per week, 365 days per year average, regardless of the actual operating schedule of the emitting facility. Thus, the model-predicted concentrations must be adjusted by a multiplying factor to reflect the pollutant concentration that the worker breathes. For example, suppose that the off-site worker and the emitting facility have the same operating schedule, perhaps 8 hours per day, 5 days per week, and 52 weeks per year. The annual average concentrations predicted by the air dispersion model must be adjusted by a factor

of 4.2 (i.e., 7/5 x 24/8). The reader is referred to the OEHHA guidelines[5] on pages 8-5 and 8-6 for further detail on this issue.

Exposure assumptions appropriate for identified sensitive receptors (e.g., 9-year-exposure for school-age child and 40-year-worker-exposure for teacher) will be used.

Table 4. Summary of ARB Guidance.

Parameter	Assumption
Pathway	
Drinking water	Site specific; see note #1 below
Fish water	Site specific; see note #1 below
Beef/dairy (pasture)	Site specific; see note #1 below
Home grown produce	May required for residential receptors
Pigs, chickens, and/or eggs	Site specific; see note #1 below
Dermal	Required for residential & worker receptors
Soil ingestion	Required for residential & worker receptors
Mother's milk	Required for residential receptors
Deposition velocity	0.02 meters per second
Fraction of homegrown fruits & vegetables consumed	5.2 or 15.0 percent
Cancer Risk Assumptions or Methods for Residential Receptors	
Exposure duration	70 years
Analysis method	Derived (Adjusted)
Cancer Risk Assumptions or Methods for Worker Receptors	
Exposure duration	40 years; see note #2 below
Analysis method	Point estimate
Chronic Non-carcinogenic Health Hazard Index Assumptions or Methods for Residential Receptors	
Analysis method	Derived (OEHHA)
Chronic Non-carcinogenic Health Hazard Index Assumptions or Methods for Worker Receptors	
Analysis method	Point estimate; see note #3 below

1. Required pathway only if the facility impacts a local fishable body of water, grazing land, dairy, or water reservoir.
2. See text discussion and Table 5 for required concentration adjustments.
3. The concentration adjustments provided in Table 5 are not necessary for non-carcinogenic chronic Health Hazard Index.

The adjustment factors for all possible operating schedules are given in Table 5. These factors are entered into HARP* by activating the worker scenario labeled "Use adjusted GLC or exposure assumptions" and entering the appropriate factor in Table 5 in the data field labeled "GLC adjustment factor." If the emitting facility operates continuously then

* Currently the only acceptable air dispersion modeling data format for HARP is that from its internal ISCST3 model. For multipathway analyses, ARB staff will work on the format of AERMOD output to make it compatible with HARP.

the user should activate the worker scenario labeled "Use modeled GLC and default exposure assumptions."

Table 5. Adjustment Factors for Off-site Worker Exposure.*

Hours of Operation per Day	Days of Operation per Week		
	1 to 5	6	7
1 to 8	4.2	3.5	3.0
9	3.7	3.1	2.7
10	3.4	2.8	2.4
11	3.1	2.5	2.2
12	2.8	2.3	2.0
13	2.6	2.2	1.8
14	2.4	2.0	1.7
15	2.2	1.9	1.6
16	2.1	1.8	1.5
17	2.0	1.6	1.4
18	1.9	1.6	1.3
19	1.8	1.5	1.3
20	1.7	1.4	1.2
21	1.6	1.3	1.1
22	1.5	1.3	1.1
23	1.5	1.2	1.0
24	1.4	1.2	1.0

* These adjustment factors should only be used when calculating worker cancer risks. The adjustment factors should not be used when calculating chronic non-carcinogenic health hazard indices.

Reporting Format

The reporting format for the HRA must follow the detailed outline presented in Appendix A. A completed Health Risk Assessment Summary form must be included in the executive summary of all health risk assessments.[10]

Cancer risk values should be reported to the nearest tenth and should be rounded up from 5 (e.g., 5.05 in a million is rounded up to 5.1 in a million). Non-carcinogenic health hazard indices should be reported to the nearest hundredth and should be rounded up from 5 (e.g., a hazard index of 0.105 is rounded to 0.11)

MEIR, MEIW, and MICR

To identify the location of the Maximum Exposed Individual Resident (MEIR); the Maximum Exposed Individual Worker (MEIW); the Maximum Individual Cancer Risk (MICR), which is simply the greater of the MEIR and MEIW, it is necessary to examine current land use and allowable land use in the vicinity of the point of maximum impact (residential, commercial/industrial or mixed use). The use of block group or census tract centroids as surrogates for the maximum exposed individuals does not provide sufficient spatial resolution and will not be approved.

Cancer risk and non-carcinogenic chronic hazard indices (HIs) must be provided for both the most exposed residential and the most exposed commercial/industrial receptors. Additionally, cancer risk and hazard index values at each sensitive receptor located

within the zone of impact must be presented in a table. The zone of impact is discussed in the next section.

Zone of Impact

In any risk assessment, it is necessary to define a zone of impact or a method to set boundaries on the analysis. ARB requires that the risk assessment shall encompass the area subject to an added lifetime potential cancer risk (all pathways) of one in a million or greater ($\geq 1.0 \times 10^{-6}$). For large rail yards and intermodal facilities, one in a million potential cancer risks could occur more than 50 km downwind, which would exceed the 50 km pollutant transport distance limitation of AERMOD and ISCST3. In those instances, it is acceptable to limit the receptor network to conform to the model limitation.

For non-carcinogens the analysis should bound the area subject to a hazard index of greater than or equal to one half (≥ 0.5).

In instances where the impact areas of two or more rail yards overlap and where the summed cancer risk for all of the overlapping impact areas is greater than ten in one million, the aggregate risk in the areas of overlap will be reported.

In addition to the high end estimates of exposure resulting from the combinations of exposure assumptions required under the Hot Spots guidance, the estimates of the range of exposures and risks, as well as the mean or typical exposure levels and risks will be provided for risk communication.

Land Use Considerations

Risk estimates are sensitive to land uses (e.g. residential, commercial, vacant) since these factors can affect exposure assumptions. If residential or worker risks are not calculated at the point of maximum impact because the land is currently vacant, the location, zoning and potential future land uses should be discussed. Updated information on current land uses is requested when updated emission estimates are reported to ARB.

Maps

Maps showing the location of the source in relation to the zone of impact must be submitted. Air dispersion modeling for sources should be conducted with receptors defined in terms of Universal Tranverse Mercator (UTM) coordinates (NAD83, UTM 10N/11N). For carcinogen impacts, total risk isopleths for facilities should be plotted on the street map at potential cancer risk intervals of 1, 10, 25, 50, 100, 250, 500, 1000, 2500, 5000, etc. in a million. Isopleths for non-carcinogenic chronic health hazard index must include levels corresponding to a HI of 0.5, 1, 3, 5, and 10.

Separate maps should be provided for each of the three risk variables: potential cancer risks, potential non-cancer acute risks*, and potential non-carcinogenic chronic health hazard index. The maps must contain an accurate scale for measuring distances and a legend. The map scale that can accommodate the isopleths and show the greatest level of detail must be used. The names of streets and other locations must be presented and be legible.

The locations of sensitive receptors should be identified on the map. If the area of the zone of impact is very large, then more detail should be devoted to higher concentration/risk areas versus lower risk areas. Land uses in the vicinity of the point of maximum impact (off-site) must be shown in detail. This may require a separate map. If sensitive receptors are located within a one mile radius of each yard or otherwise identified by ARB, then risk and hazard index values must also be presented in the form of a table including all the sensitive receptors.

Assessment of the Health Risk Associated with Other Sources

ARB will collect appropriate information for other sources significantly affecting the communities in the impacted areas. ARB will determine the health risk associated with these other sources and include these risks in the Draft HRA for each Designated Rail Yard.

Timing of the Data Submittal

The final reports of the results from emission inventory and air dispersion modeling with all of the supporting data/information must be submitted to ARB for review and approval within 30 days of the completion of the work. Table 6 lists the date requirement of the reports.

It is important to specify the timeline for ARB review and approval of all the data/information identified in the approved Plan, e.g., emission inventory, air dispersion modeling, meteorological and demographic data sets, before their use in each exposure assessment. To ensure compliance with the methodologies prescribed in this guidance document, the participating rail yards should submit the data/information collected in each component of the heath risk assessment, as described in Section of Exposure Assessment in Appendix A, to ARB for review within 10 days of the completion of each individual task.

* Due to the uncertainties in the toxicological and epidemiological studies, DPM as a whole was not assigned a short-term acute reference exposure level (REL), only some gaseous constituents of desiel exhaust were. In addition, given the multitude of activities ongoing at facilities as complex as rail yards, there are much higher level of uncertainties associated with hourly-specific emission data, which is essential to assess acute health. As such, non-cancer acute health risk will be addressed by semi-quantitative assessment and the results will be discussed in a range to reflect all of the uncertainties associated with the analysis.

Table 6: Schedule for Collecting and Compiling HRA Data

Rail Yard	Company	Date by which the Railroads will submit complete data to ARB	Date by which ARB will issue draft HRA
Commerce	UP	Sep. 30, 2006	Dec. 31, 2006
Hobart	BNSF	Sep. 30, 2006	Dec. 31, 2006
Commerce/Eastern	BNSF	Sep. 30, 2006	Dec. 31, 2006
Watson	BNSF	Sep. 30, 2006	Dec. 31, 2006
LATC	UP	Sep. 30, 2006	Dec. 31, 2006
Mira Loma	UP	Sep. 30, 2006	Dec. 31, 2006
Richmond	BNSF	Sep. 30, 2006	Dec. 31, 2006
Stockton	UP	Sep. 30, 2006	Dec. 31, 2006
Stockton	BNSF	Sep. 30, 2006	Dec. 31, 2006
Barstow	BNSF	Sep. 30, 2007	Dec. 31, 2007
Industry	UP	Sep. 30, 2007	Dec. 31, 2007
Colton	UP	Sep. 30, 2007	Dec. 31, 2007
ICTF/Dolores	UP	Sep. 30, 2007	Dec. 31, 2007
Oakland	UP	Sep. 30, 2007	Dec. 31, 2007
San Bernardino	BNSF	Sep. 30, 2007	Dec. 31, 2007
San Diego	BNSF	Sep. 30, 2007	Dec. 31, 2007

References

[1] Risk Reduction Plan to Reduce Particulate Matter Emissions from Diesel-Fueled Engines and Vehicles. Appendix VII – Risk Characterization Scenarios. ARB. October 2000. The document can be downloaded at the following link: http://www.arb.ca.gov/diesel/documents/rrpapp7.pdf

[2] ARB. 2004. Roseville Rail Yard Study. The document can be downloaded at the following link: http://www.arb.ca.gov/diesel/documents/rrstudy.htm

[3] U.S. EPA. 2003. Guideline on Air Quality Models, Appendix W of 40CFR Part 51. The document can be downloaded at the following link: http://www.epa.gov/scram001/tt25.htm#guidance

[4] U.S. EPA. 1995. User's Guide for the Industrial Source Complex (ISC3) Dispersion Models. EPA-4504/B-95-003a & EPA-4504/B-95-003b. The program and documentation can be downloaded at the following link: http://www.epa.gov/scram001/tt22.htm#isc

[5] OEHHA. 2003. "The Air Toxics Hot Spots Program Guidance Manual for Preparation of Health Risk Assessments." The document can be downloaded at the following link: http://www.oehha.ca.gov/air/hot_spots/HRSguide.html

[6] ARB. 2003. HARP User Guide. The program and document can be downloaded at the following link: http://www.arb.ca.gov/toxics/harp/harp.htm

[7] Meteorological data for ISC3 and HARP can be downloaded at the following link: http://www.aqmd.gov/smog/metdata/MeteorologicalData.html

[8] An explanation of the "Derived (Adjusted)" cancer risk method is provided at the ARB web site under frequently asked questions; refer to the following link: http://www.arb.ca.gov/toxics/harp/rmpolicyfaq.htm#11

[9] An explanation of the "Derived (OEHHA)" cancer risk method is provided at the ARB web site under frequently asked questions; refer to the following link: http://www.arb.ca.gov/toxics/harp/rmpolicyfaq.htm#10

[10] Forms mentioned here can be downloaded from SCAQMD's web site at the following link: http://www.aqmd.gov/prdas/AB2588/AB2588_forms.html.

[11] AQMD's notification procedures can be downloaded at the following link: http://www.aqmd.gov/prdas/AB2588/AB2588_B4.html

[12] ARB. 2003. Recommended Interim Risk Management Policy for Inhalation-Based Residential Cancer Risk. Letter dated 10/9/2003. The document can be downloaded at the following link: http://www.arb.ca.gov/toxics/harp/docs.htm#rm

[13] U.S. EPA. 2004. User's Guide for AMS/EPA Regulatory Model - AERMOD. EPA-454/B-03-001. The program and documentation can be downloaded at the following link: http://www.epa.gov/scram001/dispersion_prefrec.htm

[14] OEHHA. 2000. "Technical Support document for Exposure Assessment and Stochastic Analysis." The document can be downloaded at the following link: http://www.oehha.ca.gov/air/hot_spots/pdf/Stoch4f.pdf

APPENDIX A

OUTLINE FOR THE HEALTH RISK ASSESSMENT REPORT

I. Table of Contents

- Section headings with page numbers indicated.
- Tables and figures with page numbers indicated.
- Definitions and abbreviations. Must include a definition of acute, chronic, and cancer health impacts.
- Appendices with page numbers indicated.

II. Executive Summary

- Name of facility and the complete address.
- Facility ID number.
- Description of facility operations and a list identifying emitted substances, including a table of maximum 1-hour and annual emissions in units of lbs/hr and lbs/yr, respectively.
- List the multipathway substances and their pathways.
- Text presenting overview of dispersion modeling and exposure assessment.
- Text defining dose-response assessment for cancer and noncancer health impacts and a table showing target organ systems by substance for noncancer impacts.
- Summary of results. Potential cancer risks for residents must be based on 70-year, Tier-1 analysis and potential cancer risks for workers must be based on 40-year, Tier-1 analysis. (The results from any Tier-2, Tier-3, or Tier-4 evaluations must be presented in separate, clearly titled, sections, tables, figures, and text).
  - Location (address or UTM coordinates) and description of the maximum exposed individual (MEI).
  - Location (address or UTM coordinates) and description of any sensitive receptors that are above a cancer risk of ten in one million or above a noncancer health hazard index of one.
  - Text presenting an overview of the total potential multipathway cancer risk at the MEI, and sensitive receptors (if applicable). Provide a table of cancer risk by substance for the MEI. Include a statement indicating which of the substances appear to contribute to (i.e., drive) the potential health impacts. In addition, identify the exposure pathways evaluated in the HRA.
  - Provide a map of the facility and surroundings and identify the location of the MEIR, MEIW, and MICR.
  - Provide a map of 70-year lifetime cancer risk zone of impact (i.e., 1 in one million risk contour), if applicable. Also show the 10, 25, 50, 100, 250, 500, 1000, 2500, 5000, etc. in one million risk isopleths, if applicable.
  - Text presenting an overview of the acute and chronic noncancer hazard quotients or the (total) hazard indices for the MEIR, MEIW, and sensitive receptors. Include separate statements (for acute and chronic exposures)

indicating which of the substances appear to drive the potential health impacts. In addition, clearly identify the primary target organ(s) that are impacted from acute and chronic exposures.

- Identify any subpopulations (e.g., subsistence fishers) of concern.
- Table and text presenting an overview of estimates of population exposure.
- Version of the Risk Assessment Guidelines and computer program(s) used to prepare the risk assessment.

III. Main Body of Report

A. Hazard Identification

- Table and text identifying all substances emitted from the facility. Include the CAS number of substance and the physical form of the substance if possible. The complete list of the substances to be considered is contained in Appendix A of *The Air Toxics Hot Spots Program Guidance Manual for Preparation of Health Risk Assessments (August 2003)*.[5]
- Table and text identifying all substances that are evaluated for cancer risk and/or noncancer acute and chronic health impacts. In addition, identify any substances that present a potential cancer risk or chronic noncancer hazard via noninhalation routes of exposure.
- Describe the types and amounts of continuous or intermittent predictable emissions from the facility that occurred during the reporting year. As required by statute, releases from a facility include spilling, leaking, pumping, pouring, emitting, emptying, discharging, injecting, escaping (fugitive), leaching, dumping, or disposing of a substance into ambient air. Include the substance(s) released and a description of the processes that resulted in long-term and continuous releases.

B. Exposure Assessment

This section describes the information related to the air dispersion modeling process that should be reported in the risk assessment. In addition, doses calculated by pathway of exposure for each substance should be included in this section. The experienced reader should be able to reproduce the risk assessment without the need for clarification. The location of any information that is presented in appendices, on electronic media, or attached documents that supports information presented in this section, must be clearly identified by title and page number in this section's text and in the document's table of contents.

B.1. Facility Description

Report the following information regarding the facility and its surroundings:

- Facility name.
- Facility ID.
- Facility location (i.e., address).

- Local topography.
- Facility plot plan identifying: emission source locations, property line, horizontal scale, building heights and dimensions.
- Description of the site/route dependent exposure pathways. Provide a summary of the site-specific inputs used for each pathway (e.g., water or grazing intake assumptions). This information may be presented in the appendix with the information clearly presented and cross-referenced to the text.

B.2. Emissions Inventory

Report the following information regarding the facility's sources and emissions in table format; see Appendix K of OEHHA Guidelines (2003).[5] Depending on the number of sources and/or pollutants, this information may be placed in the main body of the report or in an appendix.

- Source identification number used by the facility.
- Source name.
- Source location using UTM coordinates (in meters); be sure to indicate the projection assumed (e.g., NAD 1983).
- Source base elevation (m).
- Source height (m).
- Source dimensions (e.g., stack diameter, building dimensions, area/volume size, etc.) (m).
- Stack gas exit velocity (m/s) if applicable.
- Stack gas volumetric flow rate (ACFM) if applicable.
- Stack gas exit temperature (K).
- Number of operating hours per day and per year.
- Number of operating days per week.
- Number of operating days or weeks per year.
- Report emission control equipment and efficiency by source and by substance. The description should be brief.
- Report emission inventory methods indicating whether emissions are measured or estimated.
- Report emission rates for each toxic substance, grouped by source, in table form including the following information (see Appendix K of OEHHA Guidelines, 2003). Depending on the number of sources and/or pollutants, this information may be placed in the main body of the report or in an appendix.
  - Source name.

  - Source identification number.
  - Substance name and CAS number.
  - Annual average emissions for each substance (lbs/yr & g/s). Radionuclides are reported in Curies/yr.
  - Maximum one-hour emissions for each substance (lbs/hr & g/s). Radionuclides are reported in millicuries/yr.

- Report facility total emission rates by substance for all emittants including the following information (see Appendix K of OEHHA Guidelines, 2003). This information should be in the main body of the report.
  - Substance name and CAS number.
  - Annual average emissions for each substance (lbs/yr & g/s). Radionuclides are reported in Curies/yr.
  - Maximum one-hour emissions for each substance (lbs/hr & g/s). Radionuclides are reported in millicuries/yr.

B.3. Air Dispersion Modeling

- The HRA should indicate the source and time period of the meteorological data used. Include the meteorological data electronically with the HRA.
- Include proper justification for using the meteorological data. The nearest representative meteorological station should be chosen for modeling. Usually this is simply the nearest station to the facility; however, an intervening terrain feature may dictate the use of an alternate site.
- Table and text that specifies the following information:
  - Selected model options and parameters.
  - Receptor grid spacing.
- For the MEIR, MEIW, MICR, and any sensitive receptors required by the ARB HRA Guidelines, include tables that summarize the annual average concentrations calculated for all substances.
- For the MEIR, MEIW, MICR, and any sensitive receptors required by the ARB HRA Guidelines, include tables that summarize the maximum one-hour; maximum four-, six-, or seven-hour (for those substances with RELs based on those averaging periods); and 30-day average (lead only) concentrations.

C. Risk Characterization

ARB's Hotspots Analysis and Reporting Program (HARP) generates the risk characterization data needed for the outline below. Any data needed to support the risk characterization findings should be clearly presented and referenced in the text and appendices. A listing of HARP output files that meet these HRA requirements are provided in this outline under the section entitled "Appendices." All HARP files should be included in the HRA. Ideally, the HRA report and a summary of data used in the HRA should be on paper and all data and model input and output files should be provided

electronically (i.e., CD). The ARB also requires the HRA in electronic form (i.e., pdf format).

The potential cancer risk for the MEIR and sensitive receptors of interest must be presented in the HRA's text, tables, and maps using a lifetime 70-year exposure period. MEIW location should use appropriate exposure periods. A 70-year exposure duration should be used as the basis for residential public notification and risk reduction audits and plans. All HRAs must include the results of a Tier-1 exposure assessment. If persons preparing the HRA would like to present additional information (i.e., exposure duration adjustments or the inclusions of risk characterizations using Tier-2 through Tier-4 exposure data), then this information must be presented in separate, clearly titled, sections, tables, figures, and text.

The following information should be presented in this section of the HRA. If not fully presented here, then by topic, clearly identify the section(s) and pages within the HRA where this information is presented.

- Description of receptors to be quantified.
- Identify the site/route dependent exposure pathways (e.g., water ingestion) for the receptor(s), where appropriate (e.g., MEI). Provide a summary of the site-specific inputs used for each exposure pathway (e.g., water or grazing intake assumptions). In addition, provide reference to the appendix (section and page number) that contains the modeling (i.e., HARP/dispersion modeling) files that show the same information.
- Tables and text providing the following information regarding the potential multipathway cancer risks at the MEIR, MEIW, MICR, and any sensitive receptors of concern:
  - Location in UTM coordinates
  - Contribution by substance
  - Contribution by source
  - 9- and 30-year cancer risks
- Tables and text providing the following information regarding the acute noncancer hazard quotient at the MEIR, MEIW, MICR, and any sensitive receptors of concern:
  - Location in UTM coordinates
  - Target organ(s)
  - Contribution by substance
  - Contribution by source
- Tables and text providing the following information regarding the chronic noncancer (inhalation and oral) hazard quotient at the MEIR, MEIW, and any sensitive receptors of concern:
  - Location in UTM coordinates
  - Target organ(s)
  - Contribution by substance
  - Contribution by source

- Table and text presenting estimates of population exposure. Tables should indicate the number of persons exposed to a total cancer risk greater than 10^{-6}, 10^{-5}, 10^{-4}, 10^{-3} etc. and total hazard quotient or hazard index greater than 0.5, 1.0, 3.0, 5.0, and 10.0. Total excess cancer burden should also be provided.
- Provide maps that illustrate the HRA results as noted below. The maps should be an actual street map of the area impacted by the facility with UTM coordinates and facility boundaries clearly labeled. This should be a true map (i.e., one that shows roads, structures, etc.), drawn to scale, and not just a schematic drawing. U.S. Geologic Survey 7.5 minute maps are usually the most appropriate choice. The following maps are required:
  - Locations of the MEIR, MEIW, MICR, and sensitive receptors for the cancer and noncancer acute and chronic risks. Also show the facility emission points and property boundary.
  - Total multipathway cancer risk contours for the following risk levels: 1, 10, 25, 50, 100, 250, 500, 1000, 2500, 5000, etc. in a million. Maps should be provided for the minimum exposure pathways (i.e., inhalation, soil ingestion, dermal exposure, and breast-milk consumption) and for all applicable exposure pathways (i.e., minimum exposure pathways plus additional site/route specific pathways). Include the facility location on the maps.
  - Noncancer acute and chronic hazard index contours for the following levels: 0.5, 1.0, 3.0, 5.0, and 10.0. Include the facility location.
- The risk assessor may want to include a discussion of the strengths and weaknesses of the risk analyses and associated uncertainty directly related to the facility HRA.
- If appropriate, comment on the possible alternatives for control or remedial measures.
- If possible, identify any community concerns that influence public perception of risk.

D. References

IV. Appendices

The appendices should contain all data, sample calculations, assumptions, and all modeling and risk assessment files that are needed to reproduce the HRA results. Ideally, a summary of data used in the HRA will be on paper and all data and model input and output files will be provided electronically (e.g., CD). All appendices and the information they contain should be referenced, clearly titled, and paginated. The following are potential appendix topics unless presented elsewhere in the HRA:

- List of all receptors in the zone of impact and their associated risks.
- Emissions by source.
- Census data.
- Maps and facility plot plan.
- All calculations used to determine emissions, concentrations, and potential health impacts at the MEIR, MEIW, MICR, and sensitive receptors.

- Presentation of alternate risk assessment methods (e.g., alternate exposure durations, or Tier-2 to Tier-4 evaluations with supporting information).

V. Computer Files

The list of computer files that must be submitted on CD with the HRA is as follows:

- Provide facility, device, process, emissions, and stack data in electronic transaction file, EXPORT.TRA
- ISC workbook file with all ISC parameters (filename.ISC).
- ISC input file generated by HARP when ISC is run (filename.INP).
- ISC output file generated by HARP when ISC is run (filename.OUT).
- ISC binary output files; holds χ/Q values for each hour (filename.BIN).
- List of error messages generated by ISC (filename.ERR).
- Source-receptor file; contains lists of sources and receptors for the ISC run; file generated by HARP when ISC is run (filename.SRC).
- Point estimate risk values generated by HARP; this file is updated automatically each time you perform one of the point estimate risk analysis functions (filename.RSK).
- Average and maximum χ/Q values for each source-receptor combination; values are generated by ISC (filename.XOQ).
- Plot file generated by ISC (filename.PLT).
- Representative meteorological data used for the facility air dispersion modeling (filename.MET).
- Site-specific parameters used for all receptor risk modeling (filename.SIT).
- Map file used to overlay facility and receptors (filename.DEB).

Appendix B

Calculation of Inhalation Cancer Risk for Diesel Particulate Matter

Below is a procedure for estimating the inhalation cancer risk from exposure to diesel particulate matter (DPM). Impacts to residential and worker exposures are addressed. The methods below represent a Tier-1 assessment as described by OEHHA.[5]

The inhalation cancer risk equation is as follows:

Cancer risk = Cancer Potency (CP) • Inhalation Dose (Dose-Inh)

Dose-Inh = 10^{-6} • C_{air} • DBR • (EF • ED)/AT

Where,

CP	=	Cancer potency; the cancer potency for DPM is 1.1 cancers/mg/kg-day;
Dose-inh	=	Dose through inhalation (mg/kg-day);
10^{-6}	=	Unit conversion factor;
C_{air}	=	Model-estimated DPM concentration ($\mu g/m^3$);
DBR	=	Daily breathing rate (L/kg-day);
EF	=	Exposure frequency (days/year);
ED	=	Exposure duration (years); and
AT	=	Averaging time period over which exposure is averaged, in days.

Assumptions for the above parameters are given in the table below:

Receptor	DBR	EF	ED	AT
Residential	302*	350	70	25,550
Worker	149	245	40	25,550

* 80^{th} percentile breathing rate per ARB's interim risk management guidance for inhalation risk at residential receptors.[12]

The inhalation cancer risk for a residential receptor simplifies to:

Cancer risk = 318.5 • C_{air} • 10^{-6}

The inhalation cancer risk for a worker receptor simplifies to:

Cancer risk = 62.9 • C_{air} • 10^{-6}

The model-predicted DPM concentration that a worker is exposed to (i.e., C_{air}) must be adjusted using the factors given in Table 5 of the main body of this document.